

What is claimed is:

1. A water soluble or water dispersible fluorochemical silane represented by the general formula:



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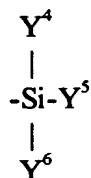
(I)

wherein X represents the residue of an initiator or hydrogen;

M^f represents units derived from one or more fluorinated monomers;

M^h represents units derived from one or more non-fluorinated monomers;

M^a represents units having a silyl group represented by the formula:



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(II)

wherein each of Y^4 , Y^5 and Y^6 independently represents an alkyl group, an aryl group or a hydrolyzable group;

G is a monovalent organic group comprising the residue of a chain transfer agent;

n represents a value of 1 to 100;

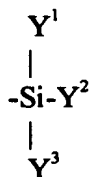
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m represents a value of 0 to 100;

and r represents a value of 0 to 100;

and $n+m+r$ is at least 2;

with the proviso that at least one of the following conditions is fulfilled: (a) G contains a silyl group of the formula:



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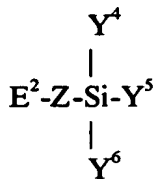
(III)

wherein Y^1 , Y^2 and Y^3 each independently represents an alkyl group, an aryl group or a hydrolyzable group and at least one of Y^1 , Y^2 and Y^3 represents a hydrolyzable water solubilising group or

(b) r is at least 1 and at least one of Y⁴, Y⁵ and Y⁶ represents a hydrolyzable water solubilizing group.

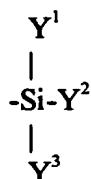
- 5 2. A water soluble or water dispersible fluorochemical silane according to claim 1 wherein said hydrolyzable water solubilizing group is an ionic group or a non-ionic group comprising a polyoxyalkylene group having 2 or 3 carbon atoms.
- 10 3. A water soluble or water dispersible fluorochemical silane according to claim 1 wherein r is 0 and wherein at least one of Y¹, Y², and Y³ represents a polyoxyalkylene group having 2 or 3 carbon atoms.
- 15 4. A water soluble or water dispersible fluorochemical silane according to claim 1 wherein r is an integer of 1 to 30 and wherein at least one of Y⁴, Y⁵, and Y⁶ represents a polyoxyalkylene group having 2 or 3 carbon atoms.
5. A water soluble or water dispersible fluorochemical silane wherein m < n.
- 20 6. A water soluble or water dispersible fluorochemical silane according to claim 1 wherein the fluorochemical silane according to formula (I) contains at least 20 % by weight of water solubilizing groups.
- 25 7. A water soluble or water dispersible fluorochemical silane according to claim 1 wherein said unit M^f is derived from an ethylenically unsaturated monomer corresponding to the formula:
- $$R_f-Q-E^1$$
- wherein R_f represents a fluoroaliphatic group comprising at least 3 carbon atoms or a fluorinated polyether group, Q represents an organic divalent linking group and E¹ represents a free radical polymerizable group.
- 30 8. A water soluble or water dispersible fluorochemical silane according to claim 7 wherein R_f represents C₄F₉-.

9. A water soluble or water dispersible fluorochemical silane according to claim 1 wherein said unit M^a is derivable from a monomer represented by the formula:



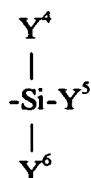
- 5 wherein Y⁴, Y⁵ and Y⁶ have a meaning as defined in claim 1, Z represents an organic divalent linking group and E² represents a free radical polymerizable group.
10. A water soluble or water dispersible fluorochemical silane according to claim 1 wherein said water soluble or water dispersible fluorochemical silane has a water solubility or water dispersibility of at least 0.1% by weight.
11. An aqueous composition comprising a water soluble or water dispersible fluorochemical silane as defined in claim 1.
- 15 12. Method of treatment of a substrate comprising applying a water soluble or water dispersible fluorochemical silane as defined in claim 1 to a substrate.
13. Method according to claim 12 further comprising the step of heating to a temperature of 40°C to 300°C.
- 20 14. Method according to claim 12 wherein said fluorochemical silane or an aqueous composition thereof is applied to said substrate in the presence of an acid or base catalyst or wherein subsequent to application of said fluorochemical silane or an aqueous composition thereof, an acid or base catalyst is applied.
- 25 15. Method according to claim 13 wherein said substrate is selected from the group consisting of ceramics, glass, stone, plastic and metal.
16. Treated substrate obtained by any of the method of claim 12.

17. Method of making a water soluble or water dispersible fluorochemical silane as defined in claim 1 comprising a free radical polymerization of fluorinated monomer and optionally a non-fluorinated monomer in the presence of a chain transfer agent wherein at least said chain transfer agent contains a silyl group represented by the formula:



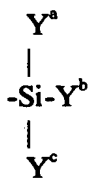
wherein Y^1 , Y^2 and Y^3 each independently represents an alkyl group, an aryl group or a hydrolyzable group and at least one of Y^1 , Y^2 and Y^3 represents a hydrolyzable water solubilising group;

and/or wherein said free radical polymerization involves copolymerization with a monomer having a silyl group represented by formula:



wherein each of Y^4 , Y^5 and Y^6 independently represents an alkyl group, an aryl group or a hydrolyzable group and at least one of Y^4 , Y^5 and Y^6 represents a hydrolyzable water solubilising group.

18. A method for making a water soluble or water dispersible fluorochemical silane as defined in claim 1 comprising preparation of a fluorochemical oligomer by free radical polymerization of a fluorinated monomer, optionally a non-fluorinated monomer in the presence of a chain transfer agent and at least said chain transfer agent contains a silyl group represented by the formula:



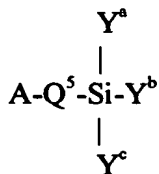
(A)

wherein Y^a , Y^b and Y^c each independently represents an alkyl group, an aryl group and at least one of Y^a , Y^b and Y^c represents a hydrolyzable group selected from an alkoxy group, an acyloxy group, an acyl group, an aryloxy group and a halogen;

and/or wherein said free radical polymerization involves copolymerization with a monomer having a silyl group represented by the above formula (A);

and wherein the thus obtained fluorochemical oligomer is further reacted with a compound containing water solubilising groups and which compound is capable of displacing one or more of the hydrolysable groups in the silyl moiety according to formula (A) above so as to introduce into said silyl moiety one or more hydrolysable water solubilising groups.

19. A method for making a water soluble or water dispersible fluorochemical silane as defined in claim 1 comprising (a) preparation of a fluorochemical oligomer by free radical polymerization of a fluorinated monomer and optionally a non-fluorinated monomer in the presence of a chain transfer agent and said chain transfer agent and/or a comonomer having a functional group available for further reaction after said free radical polymerization and being selected from the group consisting of a hydroxy group and an amino group (b) reacting a thus prepared fluorochemical oligomer with a compound according to the formula



(B)

wherein A represents a functional group capable of undergoing a condensation reaction with said functional group of said comonomer or said functional group of said chain transfer agent, Q^5 represents an organic divalent linking group, Y^a , Y^b and Y^c each independently represents an alkyl group or an aryl group and at least one of Y^a ,

Y^b and Y^c represents a hydrolysable group selected from the group consisting of halogen, an alkoxy group, an acyloxy group, an acyl group and an aryloxy group; and
(c) further reacting the thus obtained product with a compound containing water solubilising groups and which compound is capable of displacing one or more of the hydrolysable groups in the silyl moiety according to formula (B) above so as to introduce into said silyl moiety one or more hydrolysable water solubilising groups.

20. Method according to claim 18 wherein said compound containing water solubilising groups is a polyalkyleneoxide compound having a hydroxy or amino group.

21. A method according to claim 20 wherein said polyalkyleneoxide compound is a hydroxy or amino terminated C_1-C_4 alkyl ether of a polymer of ethylene oxide and/or propylene oxide.

22. A method according to claim 20 wherein said polyalkyleneoxide compound is a C_1-C_4 alkoxy polyalkyleneglycol wherein the alkylene of the polyalkylene glycol has 2 or 3 carbon atoms.